Liebert APM UPS

GUIDE SPECIFICATIONS

For a 30 to 150 kVA / kW (50 or 60Hz)

Modular Digital Uninterruptible Power Supply (UPS) System

Contents

GENERAL

1.1 SUMMARY

These specifications describe requirements for a Modular & Scalable, Digital Uninterruptible Power System (UPS) consisting of one or more single power module units connected in parallel inside a standard 600mm x 1100mm x 2000mm rack without the need for either an additional system controller or an external centralized main bypass static switch. The UPS system shall have provision for internal Modular Power Distribution Unit or PDU with optional branch circuit monitoring. The UPS shall automatically maintain AC power within specified tolerances to the critical load, without interruption (for specified duration as per battery run time), during failure or deterioration of the mains power supply. The UPS shall be expandable by paralleling additional modules of the same rating, to provide for module redundancy or load growth requirements.

The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental, and space conditions at the site. It shall include all equipment to properly interface the AC power source to the intended load and be designed for unattended operation.

1.2 STANDARDS

The UPS and all associated equipment and components shall be manufactured in accordance with the following applicable standards:

- Safety Requirements: IEC 62040-1-1, EN 50091-1-1
- EMC: IEC 62040-2 (Class A), EN 50091-2 (Class A)
- Performance: IEC 62040-3 (VFI SS 111), EN50091-3

The above mentioned product standards incorporate relevant compliance clauses with generic IEC and EN standards for safety (60950), electromagnetic emission and immunity (61000 series) and construction (60146 series and 60529).

For more details, see below:

- IEC 61000-3-4
- IEC 61000-4-2, 4, 5, 6, 8, 11
- EN60950
- EN60529
- IEC 60146-1-1

The UPS is CE marked in accordance with EEC directives 73/23 “low voltage” and 89/336 “electromagnetic compatibility”.

The Quality System for the engineering and manufacturing facility certificated to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

A. For non-redundant operation (applicable, not applicable), the UPS system shall be sized to provide a minimum of ____ kVA / kW output.

B. For redundant operation (applicable, not applicable), the UPS system shall be sized to provide a minimum of ____ kVA / kW output with ___ module(s) out of service.

Load voltage and bypass line voltage will be ___VAC, three phase and neutral. Input voltage will be ___ VAC, three phase.

The battery system shall have a capacity of ___kW for at least ___ minutes at 25ºC.

The battery will be installed:

On open racks	( )
On cladded racks	( )
In battery cabinets	( )

1.3.2 Modes of Operation

The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

A. **Normal:** UPS inverters continuously powers the critical AC load. The rectifier/chargers derives power from the mains AC power supply source converting this to DC power to supply the inverters, while simultaneously float/boost charging the battery system. Power supplied by the UPS inverters is, to within specified tolerances, at rated voltage and frequency.

B. **Battery:** Upon failure of the mains AC power supply source, the critical AC load is powered by the inverter, which gets, without interruption, power from the battery system. There shall be no interruption in power to the critical load upon failure or restoration of the mains AC power supply source. Upon restoration of the mains AC power supply source, power to the rectifier initially is restricted by a gradual power walk-in. Following the short power walk-in period, the rectifier powers the inverter and simultaneously recharges the battery through the battery converter. This shall be an automatic function and shall cause no interruption to the critical load.

C. **Off-Battery or Frequency Converter:** When the battery system is taken out of service for maintenance or the UPS is used as a frequency converter, it is disconnected from the battery converter and inverter by means of (an) external disconnect breaker(s). The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

D. **Bypass:** If the inverter fails, or the inverter overload capacity is exceeded, or the inverter is manually turned off by user, and at this time the inverter is synchronous with the bypass, the static transfer switch shall perform a transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load. If the inverter is asynchronous with the bypass, the static switch will perform a transfer of the load from the inverter to the bypass with interruption in power to critical AC load.

This interruption must be less than 15ms (in 50Hz), or less than 13.33ms (in 60Hz). The static bypass shall be able to support continuously 135% of rated UPS capacity.

E. **Maintenance:** Each UPS has an internal maintenance bypass (external maintenance bypass is an external maintenance bypass which can be installed in the Maintenance Bypass Cabinet-MCB). If the UPS needs to be maintained or repaired, after the inverter is turned off and the load is transferred to bypass, the internal maintenance bypass or external maintenance bypass can be turned on and the UPS can be shut down and the battery can be disconnected for maintenance purposes.

F. **Module Paralleling:** For higher capacity or higher reliability, power modules can be paralleled inside the UPS rack; parallel power modules automatically share the load. The largest parallel capacity is up to five times the nominal load of each power module composing the system. Each power module shall have its own intelligent control logic to avoid single point of failure. There should not be any common controller that controls all power modules in parallel.

G. **Regen Mode:** The UPS rack system shall have the ability to perform self test for full rated capacity without using any external load banks. In this mode, UPS rectifier, inverter and static bypass shall be tested up to full load capacity without any failure. Power consumption in this mode shall only be full load losses of UPS.

H. **Source Share mode:** A part of the critical AC load is supplied by the mains AC input, and the remainder of the critical AC load is supplied by battery. The ratio of the input and the remainder of the critical AC load is supplied by battery. The ratio of the power. This mode is mostly used in generator mode when a smaller generator than needed is employed.

1.3.3 Scalability & Modularity

The UPS rack system shall consist of hot swappable power modules with each modules rated for 30kVA/kW and scalable up to 150kVA/kW. Modularity design of the UPS system shall enable ease of service and upgradability or downgrade-ability of the UPS rack system without interruption to the whole system.

1.3.3 Performance Requirements

The UPS is VFI classified (according to IEC 62040-3) producing an output waveform that is independent of both the input supply frequency and voltage.

1.3.3.1 UPS Module AC Input

A. **Voltage Range:** 305 to 477V

B. **Frequency Range:** 40~70Hz

C. **Power Walk-In:** maximum 30 seconds to full rated input current. Field selectable from 5 to 30 seconds adjustable with 5-second increments.

D. **Power Factor:** Shall be > 0.99 without any option at full rated UPS output load.

E. **Generator Adaptability:**

   UPS input current limit can be adjusted to suit the generator power rating.

   Wide input frequency range is permissible.

F. **Current Distortion:** Less than 3% at full rated UPS output load and 100% balanced non-linear load (with input voltage THD ≤ 2%).

1.3.3.2 UPS Module AC Output

Three-phase, 4-wire plus ground.

A. **Load Rating:** UPS shall be able to support Unity power factor load rating at indicated ambient temperature for any combination of linear and non-linear loads.

B. **Voltage Stability:** 1% steady state for balanced loads, 2% for 100% unbalanced loads.

C. **Bypass Line Sync Range:** Field selectable ±0.5 to 3.0 Hz at 1.0 Hz increments. Default shall be ± 2.0 Hz

D. **Frequency Stability:** Frequency regulation, whilst free-running on battery, shall be ± 0.05 Hz. If the bypass is available and within limits, even if the UPS is on battery operation, in this case, the output will sync to the bypass. Nominal frequency shall be +/-0.05% in single module mode, and 0.25% in parallel mode.

E. **Frequency Slew Rate:** For single mode, the slew rate shall be adjustable from 0.1Hz/s to 3Hz/s (default setting shall be 0.1 Hz/s). For parallel mode, the slew rate shall be fixed to a suitable value (default setting shall be 1 Hz/s).

F. **Efficiency:** It is defined as output kW / input kW:

   - Up to 96% at full rated load, nominal input, no battery. Greater than 95% for loads over 25%.
   - Not less than 98% at full rated load when supplying the load through the static bypass.

G. **Phase Unbalance:** 120º ±1º el. for 100% balanced or unbalanced loads.

H. **Voltage Transients:** ± 5% for 100% output load step up or step down.

I. **Transient Recovery Time:** Return to within 5% of steady state output voltage within half a cycle.

J. Voltage Distortion (at 400V, 100% rated load with crest factor 3:1):

- Less than 1% total harmonic distortion (THD) for linear loads
- 4% THD for 100% balanced non-linear loads (3:1 crest factor)
- 5% THD for 100% unbalanced non-linear loads (3:1 crest factor)

K. Module Overload Capability at Rated Output Voltage:

- 150% of UPS rated output with a resistive load for one minute.
- 125% of UPS rated output with a resistive load for ten minutes. The UPS will achieve the overload mentioned above ≤ 30 °C operating temperature, nominal input voltage and when the battery is in a full charged condition.
- 110% of UPS rated output with a resistive load for one hour. The UPS will achieve the overload mentioned above with 380/400/415V nominal input and output voltage and when the battery is fully charged.

L. Module Current Limit: I_{peak} is equal to 3.4xIn for up to 200ms.

1.3.3.3 Bypass Static Switch

A. Voltage Range:

Upper limit: +10%, +15% or +20%, default shall be +15%
Lower limit: -10%, -20%, -30% or -40%, default shall be -20%

B. Frequency Range: ±2.5%, ±5%, ±10%, ±20% Field Selectable

C. Overload Capability: (specified without fuses)

For 100% to 135% rated output current, long-term operation (no time limitation).

From greater than 135% to 170% rated output current, 10 minutes.

For 1000% of full UPS rated output current, 100 milliseconds.

D. Neutral Conductor Sizing: 1.7 times rated current.

1.3.3.4 Earthing

The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment earth terminal. Provisions for local bonding are to be provided.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Operating Ambient Temperature

UPS: 0ºC to 40ºC

Battery: 25ºC ± 5°C for optimum battery performance.

1.4.2 Storage/Transport Ambient Temperature

UPS: -20ºC to 70ºC.

Battery: -20°C to 30°C, 20ºC for optimum battery storage.

1.4.3 Relative Humidity

0 to 95%, non-condensing.

1.4.4 Altitude

Operating: To 1000 m above sea level without de-rating.

1.4.5 Immunity

A. Conduction

IEC 62040-2, class A

B. Radiation

IEC 62040-2, class A

C. Harmonic

IEC 61000-3-4

D. Immunity

EN 61000-4-2.3.4.6.8.9.11 Level III

EN 61000-4-5 Level IV

1.5 UPS DIMENSION

The UPS dimension shall be housed in 600mm x 1100mm x 2000mm (w x h x d) free standing rack enclosure for the UPS range of 30kVA – 150kVA.

1.6 UPS DELIVERY SUBMITTALS

The specified UPS shall be supplied with one (1) user manual to include details of:

A. Functional description of the equipment with block diagrams.

B. Detailed installation drawings, including all terminal locations for power and control connections for both the UPS and battery system.

C. Safety precautions.

D. Step-by-step operating procedures

E. General maintenance guidelines

The UPS shall be supplied with a record of pre-shipment final factory test report.

1.7 WARRANTY

1.7.1 UPS Warranty

The UPS manufacturer shall warrant the unit against defects in workmanship and materials for 12 months after initial start-up date or 15 months after ship date, whichever comes first.

1.7.2 Battery Warranty

The battery manufacturer's standard warranty shall be passed through to the end user.

1.8 QUALITY ASSURANCE

1.8.1 Manufacturer Qualifications

A minimum of twenty years experience in the design, manufacture and testing of solid-state UPS systems is required. The manufacturer shall be certified to ISO 9001.

1.7.2 Factory Testing

Before shipment, the system shall be fully and completely tested to ensure compliance with the specification.

PRODUCT

2.1 FABRICATION

2.1.1 Materials

All materials of the UPS Rack System shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All electronic components shall be accessible from the front.

2.1.2 Wiring

Wiring practices, materials and coding shall be in accordance with the requirements of IEC. All electrical power connections shall be torqued to the required value and marked with a visual indicator (English tag).

Provision shall be made in the cabinets to permit installation of input, output, and external control cabling. Provision shall be made for bottom access, allowing for adequate cable bend radius, to the input and output connections.

2.1.3 Construction

The UPS shall be housed in an IP20 enclosure, designed for floor mounting. The UPS rack shall be structurally adequate and have provisions for forklift handling. Maximum cabinet height shall be 2 meters for all UPS range.

2.1.4 Cooling

Adequate ventilation shall be provided to ensure that all components are operated well within temperature ratings.

Temperature sensors shall be provided to monitor UPS internal temperature. Upon detection of temperatures in excess of manufacturer's recommendations, the sensors shall cause audible and visual alarms to be sounded at the UPS control panel. A separate room ambient temperature sensor shall be provided to allow control of the battery charging voltage with change of temperature.

The air should flow into the cabinet from the front and ventilate from the rear.

No clearance is required at the rear of the UPS for the purpose of ventilation or maintenance.

2.2 EQUIPMENT

2.2.1 UPS System

The UPS system shall consist of an appropriate number of power module units to meet capacity and redundancy requirements. Each UPS System shall consist of standard rack enclosure, three phase power module/s, mains bypass static, protective devices and accessories as specified. Each UPS system shall also include a battery disconnect and battery system. The UPS system shall be modular/scalable in design and shall be hot swappable with internal power distribution modules and branch monitoring system.

2.2.2 Configurations

The UPS rack system shall consist of either a single power module unit, or two or more (up to a maximum of five) units in the same UPS rack enclosure. Systems greater than one power module shall operate simultaneously in a parallel configuration with the load shared equally between the connected modules. With the exception of a single module configuration, the system shall be redundant or non-redundant as stated elsewhere in this specification.

A. **Non-redundant system:** all the modules making up the UPS system shall supply the full rated load. If a module should malfunction, and that the remaining modules cannot support the load, the load has to be transferred, automatically and uninterrupted, to the bypass line by the use of the internal static mains bypass switch.

B. **Redundant system:** the UPS system shall have one or more module(s) than required to supply the full rated load. The malfunction of one of the modules shall cause that module to be disconnected from the critical load and the remaining module(s) shall continue to carry the load. Upon repair of the module, it shall be reconnected to the critical load to resume redundant operation. Any module shall also be capable of being taken off the critical load manually for maintenance without disturbing the critical load bus. Module redundancy level shall be a predefined number of modules that are required to supply the full rated load. With the number of connected modules equal to this value, a malfunction of another module shall cause the load to be transferred automatically and uninterrupted to the bypass line by the use of the static mains bypass switch.

2.2.3 System Protection

The UPS shall have built-in protection against: surges, sags, and over-current from the AC rectifier input source, over-voltage and voltage surges from output terminals of paralleled sources, and load switching and circuit breaker operation in the distribution system.

The UPS rack system shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting current limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off line. The load shall be automatically transferred to the bypass line uninterrupted, should the connected critical load exceed the

capacity of the available on-line modules. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

2.3 STANDARD COMPONENTS

2.3.1 Rectifier

The term rectifier shall denote the solid-state equipment and controls necessary to convert AC to regulated DC for input to the inverter. The rectifier shall be of DSP (Digital Signal Processor) controlled design and utilize insulated gate bipolar transistors (IGBTs).

A. Input Current Total Harmonic Distortion: Less than 3% at full rated UPS output load and 100% balance non-linear load (with input voltage THD ≤ 2%).

B. Power factor correction: The rectifier also performs a PFC function; input power factor shall be a minimum 0.99.

C. AC Input Current Limiting:

The maximum Input current limit can be reduced at 100% for generator operation.

D. Input Power Walk-in: The rectifier/charger shall provide a feature that limits the total initial power requirements; the power of rectifier will increase gradually and power walk-in time can be set from 5 seconds to 30 seconds (default shall be 10 seconds).

E. Mains AC Input phase sequence reverse protection: Before soft starting of the rectifier, if the phase sequence of the main AC input is reversed, the rectifier will not start and an alarm displayed on the LCD.

F. Input Over Current Protection: Each AC phase is individually fused so that loss of any semiconductor shall not cause cascading failures.

2.3.2 Battery converter

Batteries can be VRLA (Maintenance-Free), Ni-Cd or Wet Cell type.

Constant current boost charging, constant voltage boost charging, float charging (float charging compensation) and EOD protection are available for different kinds of batteries.

A. Charging: In addition to supplying power to the load, the battery converter shall be capable of producing a battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. Ripple voltage at the battery terminal (RMS) should be less than 1%, and ripple current must not exceed 5% (of C-10 Ah rating) nominal discharging current. (Number of battery is 30 - 40 blocks, nominal voltage is 12V per block).

B. Discharging: The battery converter will supply power to the inverter when the rectifier is shut down or in joint mode, and also the rectifier is current limiting.

2.3.3 Inverter

The term inverter shall denote the equipment and controls to convert DC from the rectifier or battery converter to provide AC power to the load. The inverter shall be solid-state, capable of providing the rated output power. The inverter shall be of Vector Controlled design and utilize insulated gate bipolar transistors (IGBTs), switching at high frequency in order to minimize output voltage distortion.

A. Overload Capability:

- 150% of UPS rated output with a resistive load for one minute.
- 125% of UPS rated output with a resistive load for ten minutes.
- 110% of UPS rated output with a resistive load for one hour.

B. Output Frequency: The inverter shall track the bypass mains supply continuously providing the bypass source remains within the limits for the rated frequency (of either 50 or 60Hz). The inverter will change its frequency at 0.1Hz per second to maintain synchronous operation with the bypass. This shall allow make-before-break transfers of the load between the inverter and the bypass mains supply. If the bypass mains supply frequency falls outside of these limits, the inverter shall revert to an internal digital oscillator that maintains the inverter output frequency to within +/-0.05% of nominal frequency in single module mode and 0.25% in parallel mode.

C. Phase-to-Phase Balance: System logic shall provide individual phase voltage compensation to obtain phase balance of ±1% under all conditions including up to 100% unbalanced non-linear load.

D. Fault Sensing and Isolation: Fault sensing shall be provided to isolate a malfunctioning inverter from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits. The inverter output static switch shall be switched off to isolate a malfunctioning module from the critical load.

E. Battery Protection: The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Shutdown of the inverter shall be initiated when the battery has reached the end of discharge (EOD) voltage. The battery EOD voltage shall be calculated and

automatically adjusted (increased) for reduced load conditions to allow for extended autonomy periods without damage to the battery.

2.3.4 Static Bypass

For time when maintenance is required or when the inverter cannot maintain voltage to the load due to sustained overload, current limiting or malfunction, a bypass circuit shall be provided for each single module that forms part of the UPS system. The modular bypass circuit(s) shall provide for isolation of the inverter(s) and provide a path for power directly from an alternate AC (bypass) source. The UPS control shall constantly monitor the availability of the inverter bypass circuit to perform a transfer. The inverter bypass of each module shall consist of a static transfer switch, operating in conjunction with the inverter output static switch. The static switches shall denote the solid-state devices that, operating simultaneously, can instantaneously connect the load to the alternate AC source.

A. **Manual Load Transfers:** A manual load transfer between the inverter output and the alternate AC source shall be initiated from the control panel.
B. **Automatic Load Transfers:** An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload or short circuit condition is sustained for a period in excess of the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load back to the inverter only after the load has returned to a level within the rating of the inverter source.
C. **Back-feed Protection:** Using another optional (customer-supplied) contactor located upstream of the UPS Bypass input and whose trip coil control voltage comes from the input bypass line voltage, the UPS shall provide a normally closed contact to be used for isolating the bypass source to protect the operator against back-feed of energy resulting from a short-circuit of the bypass line SCRs. That is, in the event that the UPS works on Battery mode and no main input (Rectifier and Bypass) is available, the contactor cannot be closed. So if the bypass line SCRs are short-circuited, the UPS will be still disconnected from the Bypass supply.

2.3.5 Internal Maintenance Bypass

A fully rated bypass circuit shall be fitted on all single module UPS systems to provide an alternative path for power flow from the alternate AC supply to the critical load for the purpose of maintaining the UPS when it is completely powered down. A Maintenance Bypass protection shall be provided; it will be activated when the Maintenance Bypass Switch is closed before the inverter shutdown.

2.3.6 Man-Machine Interface (MMI)

A. **UPS Display and Control Panel:** Each UPS module shall be equipped with a 320 x 240 dot graphic LCD display (Dimension [L x H] = 160x109 mm). This shall

automatically provide all information relating to the current status of the UPS as well as being capable of displaying metered values. The display shall be menu-driven, permitting the user to easily navigate through operator screens. The LCD shall be able to store 512 historical event records that can be retrieved and reference and diagnosis.

B. Metered Values: An MCU or DSP shall control the display functions of the monitoring system. All three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate (±1%) representation of non-sinusoidal waveforms typical of computers and other sensitive loads. The following parameters shall be displayed:

-
- **Main input**
  - Three-phase main input line-to-neutral voltage
  - Three-phase main input line-to-line voltage
  - Three-phase main input current
  - Main input frequency
  - Three-phase input power factor
- **Bypass**
  - Each phase bypass input line-to-neutral voltage
  - Bypass input line-to-line voltage
  - Bypass input frequency
- **UPS output**
  - Each phase output voltage of UPS
  - Each phase output current of UPS
  - Output line-to-line voltage of UPS
  - Power factor of each phase
  - UPS output frequency
- **Local load**
  - Load of each phase (% of total load)
  - Active power, apparent and reactive power of each phase (output)
  - Load crest factor
- **Battery**
  - Battery bus voltage
  - Battery current
  - Forecasted Battery backup time (remaining time)
  - Battery temperature (in degree centigrade)
- **Parallel load**
  - Apparent power of each output phase (for parallel operation system)
  - Active power of each output phase (for parallel operation system)

- Inactive power (Reactive power) of each output phase (for parallel operation system)

- **Input/Output transformer when installed**
  - Phase to Neutral (L-N) voltage (V)
  - Phase to Phase (L-L) voltage (V)

- **SPM Branch Metering**
  - Active power out (kW)
  - Apparent power out (kVA)
  - Phase to Phase current (A)
  - Phase to Neutral (A)
  - Load percentage (%)
  - Power factor
  - Electric energy (kWh)
  - MCB state
  - Current Ripple Coefficient

C. **Power Flow Mimic:** Each UPS module shall be equipped with a mimic to indicate power flow to the critical load along with an indication of the availability of the rectifier/charger, battery, automatic bypass, inverter, load. The mimic shall provide a quick and easy indication of the load level (displayed on LCD), including for overload conditions (displayed on LCD). This power flow is also shown in the LCD menu.

D. **Alarms and Status Information:** Alarm and status conditions shall be reported at a single module UPS system or at a paralleled module UPS or both. The display and control panel shall report the alarms and status information listed below. Each alarm shall be visually displayed in text form and an audible alarm will sound for each alarm displayed (see the following table).

Inverter comm. Fail	Bypass phase reverse	Rectifier in setting	Batt. capacity testing
Rectifier comm. Fail	Load impact transfer	MBP-T cabinet Fans Fault	Batt. maint. Testing
Parallel comm. Fail	Battery boost charging	Ext Input TX Overtemp	UPS system testing
Battery overtemp.	Battery discharging	Ext Output TX Overtemp	Inverter in setting
Ambient overtemp.	Battery period testing	Battery Room Alarm	Rectifier in setting
Battery fault	Transfer time-out	Battery reverse	MBP-T cabinet Fans Fault
Replace battery	DC bus abnormal	No battery	Ext Input TX Overtemp
Battery low pre-warning	Parallel board fault	Auto start	Ext Output TX Overtemp
Battery end of discharge	DC bus over voltage	REC FLASH UPDATE	Battery Room Alarm
Mains volt. Abnormal	Bypass over current	INV FLASH UPDATE	Battery reverse
Mains undervoltage	Setting save error	MONITOR FLASH UPDATE	No battery
Mains freq. abnormal	Mains neutral lost	Input contactor fault	Auto start
Rectifier fault	Protocol version clash	Contactor P.S. 1 fault	REC FLASH UPDATE
Rectifier overtemp.	Battery ground fault	Contactor P.S. 2 fault	INV FLASH UPDATE
Charger fault	Inv. turned ON manually	DSP firmware error	MONITOR FLASH UPDATE

Control power 1 fail	Inv. turned OFF manually	SPM Board Not Ready	Input contactor fault
Mains phase reversed	EPO	SPM CRC Check Error	Contactor P.S. 1 fault
Rectifier overcurrent	Transfer confirm	SPM Branch Curr Over LL	Contactor P.S. 2 fault
Soft start fail	Transfer cancel	SPM Branch Curr Over HL	DSP firmware error
Bypass unable to trace	Fault reset	SPM Branch Over Current	SPM Board Not Ready
Bypass abnormal	Alarm silence	SPM Branch 1 Inrush OC	SPM CRC Check Error
Inverter asynchronous	Bypass mode	SPM Branch Breaker Fail	SPM Branch Curr Over LL
Inverter fault	Normal mode	SPM Internal Comm Failure	SPM Branch Curr Over HL
Inverter overtemp.	Battery mode	SPM Maitainance Bypass Breaker Close	SPM Branch Over Current
Fan fault	Check UPS output	SPM Output Breaker Open	SPM Branch 1 Inrush OC
Main STS fail	Generator connected	Bypass mode	SPM Branch Breaker Fail
Bypass STS fail	BCB open	Normal mode	SPM Internal Comm Failure
Operation invalid	BCB closed	Battery mode	SPM Maitainance Bypass Breaker Close
Output fuse fail	Battery float charging	Check UPS output	SPM Output Breaker Open
Control power 2 fail	Battery boost charging	Generator connected	Turn on fail
Unit over load	Battery discharging	BCB open	Alarm reset
Byp. abnormal shutdown	Battery period testing	BCB closed	UPS system testing
Inverter over current	Batt. capacity testing	Battery float charging	Inverter in setting
	Batt. maint. Testing		

E. **Inverter ON/OFF:** Each UPS module shall be equipped with an inverter ON/OFF buttons which will transfer the load from all UPS modules to the bypass mains supply, if it is available. The inverter ON/OFF control shall be protected under menu confirm protect if the bypass mains is not available.

2.3.7 Communication Ports

The UPS shall have input and output volta-free contactsa to provide the following interfaces:

- EPO
- Environment parameter input interface
- User communication interface
- Intellislot intelligent card interface
- Temperature detection interface

See Section 2.4 for a description of the required optional equipment.

2.3.8 Software Compatibility

The UPS shall have optional software available for monitoring, control and event management.
The available solutions shall provide:

- users with basic UPS operating status plus automated shutdown of a computers' Operating System in the event of an extended power outage.
- cost-efficient, centralized monitoring and event management of UPS, Environmental and Power systems that can utilize an existing network infrastructure

2.3.9 LBS (Load Bus Synchronizer)

The objective of the Load Bus Synchronizer (LBS) is to keep the output of two independent UPS systems (either two independent single units OR two independent parallel systems each with and without Main Static Switch) in synchronization even when the two systems are operating on different modes (bypass/inverter) or on batteries. It is usually used with Static Transfer Switches to achieve Dual Bus Power Supply configuration.
LBS shall be able to synchronize systems of same type and brand, each system composed of same type and brand paralleled UPS's (with TWO completely different sources of incoming power to UPS systems).
With optional LBS adapter it shall be possible to synchronize systems of different type and brand, each system composed of same type and brand paralleled UPS's (with TWO completely different sources of incoming power to UPS systems).

2.3.10 Internal modular Power Distribution Unit (PDU) with optional Branch Circuit Monitoring System

The UPS rack system shall be equipped with an internal output distribution that can offer up to 18 single pole MCBs per PDU module and a total of up to 3 PDU modules with 54 single pole MCBs. These shall be orated 10-63A single pole MCBs. An internal intelligent branch circuit monitoring system shall also be fitted inside the UPS rack system for continuous monitoring of each output branch distribution.

2.4 OPTIONS

2.4.1 Optional Communications

A. **SNMP/HTTP Network Interface Card:** The UPS shall have an optional, internally fitted network interface card that will provide real-time status information over an 10/100 base T Ethernet to / for users. The network interface card will support SNMP v1, v2c and be MIB II compatible for integration into an ENP monitoring solution or a Network Management System. The card supports SNMP traps for up to 20 destinations and supports LGP and RFC1628 MIB definitions. UPS information will also be available over the network via a web browser via an HTTP page. The card supports static as well as DHCP, and BootP boot modes of operation for plug-and-play network installations. The card is also configurable via the network using the HTTP web page, Telnet session or serial interface. Configuration properties include device naming, and specific service enable / disable and control enable / disable. The card provides configuration and control security through a user name and password. The cards firmware can also be update such that future releases can be downloaded to enjoy card enhancements.

B. **RS-485 Interface Card:** The UPS shall have an optional, internally fitted RS-485 interface card that will provide real-time status information over a 2 or 4-wire RS-485 connection. The RS-485 Interface Card will support ModBus RTU, and JBus.

2.4.2 Battery Start

The UPS shall be able to start up and run on battery without any incoming mains available. The above functionality shall be achieved also when more UPSs are connected in parallel (either for redundancy or for capacity).

2.4.4 Battery Cabinet

Batteries shall be housed in a suitable rack sized cabinet matching in appearance, height and depth of the UPS rack. This matching battery cabinet shall contain the batteries and the battery circuit breaker for taking out the batteries for maintenance.

2.4.5 External battery temperature sensor

To ensure temperature compensated charging to protect battery life, a battery temperature-monitoring probe is necessary to monitor the battery enclosure temperature rise caused by the AC mains power loss and of the battery's internal resistance when operating. The probe system includes one battery temperature sensor and one temperature transport.